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# An Evaluation of Learning and Teaching Initiatives for BIM Education at Queensland University of Technology (QUT)

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## Abstract

Many universities are trying to incorporate building information modelling (BIM) into the curriculum. To cope with this, learning and teaching support for BIM educators is needed. However, there is limited study on how to design appropriate learning and teaching support for BIM education and evaluate its effectiveness. This paper aims to present the design of the learning and teaching initiatives, comprising of a BIM online training module and BIM workshops, for BIM educators at the Queensland University of Technology (QUT) and evaluates its effectiveness. Results of the online training module and the BIM workshops evaluation survey shows that the participants' BIM knowledge had been improved and their awareness for BIM education had been raised. The project contributed to building up the capacity of QUT academic staff and supporting strategic change for the enhancement of learning and teaching on BIM education.

**Keywords:** Learning and teaching, BIM, Education

## 1 Introduction

Building information modelling (BIM) has been widely adopted in architecture, engineering and construction (AEC) to yield the benefits such as improved visualization and project coordination, reduced waste, cost and time (Azhar 2011; McGraw Hill Construction 2009, 2014a, b & c). Many national governments have already made BIM a mandatory requirement such as the United States, Singapore, the United Kingdom, Norway, Denmark, Finland, Hong Kong, South Korea, Netherlands (Zeiss, 2013 July 15) and Dubai (Staff 2014 May 25). The Australian government may follow suit in the future to align with the international standards.

This mandatory requirement has created the need for AEC educators to train “BIM ready” graduates to meet industry requirements across the globe (Rooney 2014); the need for skills, learning and training needs analysis having been earlier identified during the CIB IDS Finnish Workshop (Owen et al 2009). Hence, it is indispensable for universities to incorporate BIM into AEC education and strengthen the capability of AEC educators to cope with the change (Barison and Santos 2010, 2011; Sacks & Barak, 2010; Sacks & Pikas 2013).

Lack of experienced BIM educators is a recognized challenge for adopting BIM in AEC education (e.g. Azhar 2011; Becerik-Gerber et al 2011; Wong et al 2011; Sacks and Pikas 2013). Learning and teaching support for AEC academics in such a change has been inadequate. Gearing up academics for collaborative BIM education is an important but rather uncharted area in BIM education. Designing effective learning and teaching initiatives for BIM education is definitely a challenge.

The School of Civil Engineering and Built Environment (CEBE) at QUT is undertaking a curriculum revamp for construction management units. There is a vision to incorporate BIM into the curricula of undergraduate programs of CEBE. Thus, it was timely to evaluate on the effectiveness of the learning and teaching initiatives supported by the Science and Engineering Faculty and shed some lights on future learning and teaching strategies for BIM education.

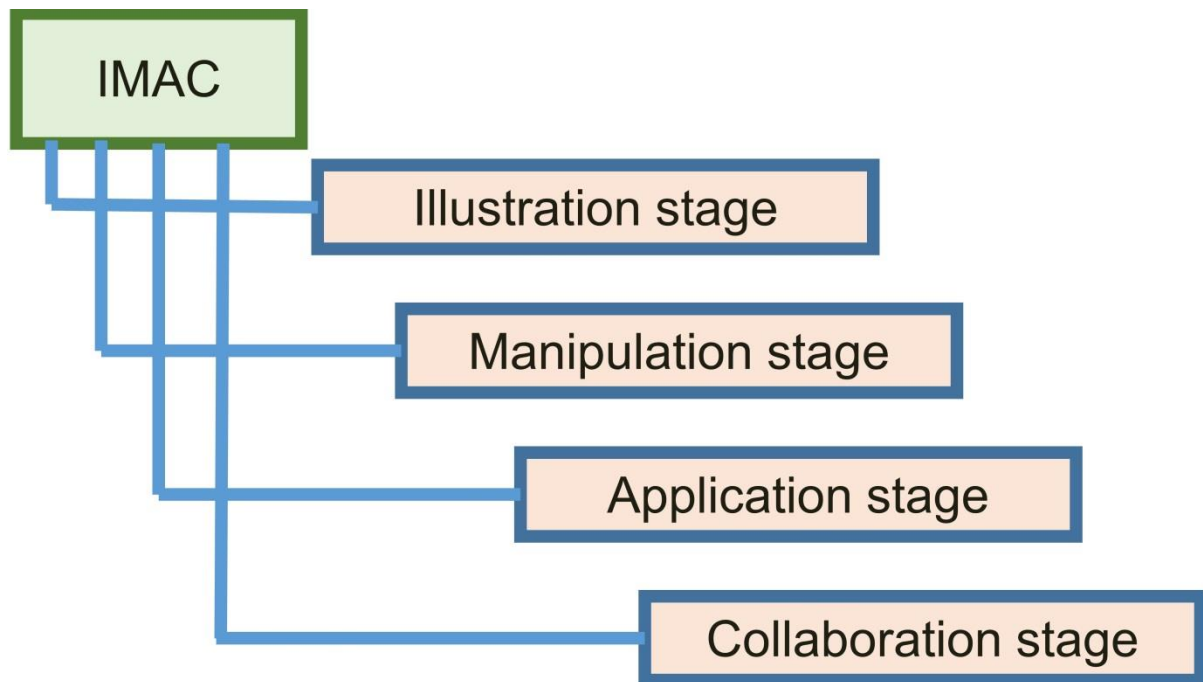
## 2 Challenges for BIM Education

Traditionally, the universities offering AEC courses play the role of educating the building professionals for the next generation. However, BIM is new and it changes the practices across AEC industries. The number of university educators who know about BIM is limited. Learning and teaching support is needed for upskilling of university educators to incorporate BIM into the AEC curriculum.

In fact, there are lots of challenges that BIM educators need to get through. According to Macdonald (2012), it is hard to squeeze BIM into the already very tight AEC curriculum. It is difficult for some educators to change their teaching habits. They may not want to move to a new area which is not their expertise. BIM technology changes quickly, making it hard for the academics to catch up. Changing the teaching approach from mass lecture to small workshop to accommodate a large cohort of AEC students is a real challenge.

One of the learning and teaching initiatives for BIM education at national level in Australia was the Office of Learning and Teaching (OLT) Project “Collaborative Building Design Education Using Building Information Modelling (CodeBIM)” led by Prof Julie Mills of the University of South Australia with partners from the University of Technology, Sydney and the University of Newcastle (Macdonald 2012; Mills et al 2013).

The OLT project developed a transferable curriculum framework called “IMAC” (Figure 1) that can be used by any university that offer architecture, engineering or construction degrees. The framework would be useful for BIM educators to assess the current level of BIM and collaborative design education in their faculty or school and compare to the ideal level for the AEC industry. While the framework sheds light on benchmarking the level of BIM education at curriculum level, the BIM educators would need more learning and teaching support for them to incorporate BIM into their teaching.



**Figure 1** IMAC framework (MacDonald, 2012)

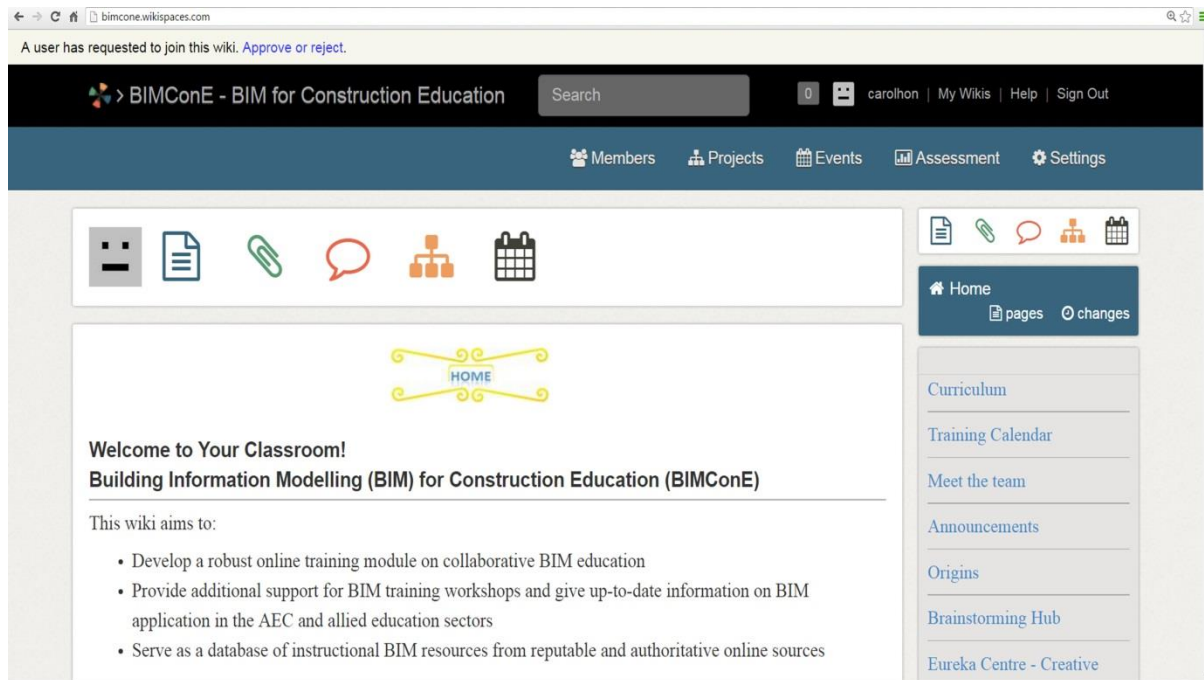
### 3. The design of learning and teaching support for BIM education

The Science and Engineering Faculty at QUT funded a learning and teaching project to provide learning and teaching support for BIM education (Hon et al 2015). The project aims to raise the awareness of BIM among academics and arouse interests in the future uptake of BIM into their units. To identify the learning and teaching support needs from the academics, a gap analysis was done. Four interviews were conducted with two subject area coordinators and academic staff representing the disciplines of civil engineering, construction and project management, and property and planning respectively to reveal the current BIM adoption and awareness and explore their needs and preferences for the design of learning and teaching support for BIM education.

The interviewees reflected that they would need handy education materials to be used in class that are directly related to their disciplines. They would also like to have carefully selected information to guide them understand the essentials of BIM in a short-time frame. With reference to their learning and teaching support needs, the project was designed to: 1) develop an online training module; and 2) conduct BIM workshops. They are described in more detail below.

#### 3.1 Design for an online training module

An online training module BIMConE (<http://bimcone.wikispaces.com/>) (Figure 2) was developed and launched through wikispaces for engaging interested QUT staff to upskill for BIM education. The online training module was rolled out in a 4 weeks span starting from 22 February Week 0 of semester 1 2016, to maintain project momentum as well as ensure sustained participant interest. The design of the online training module was self-paced without formal obligation.



**Figure 2** A Screen capture of BIMConE

There were four modules, including an introduction module providing guides for users of the online training module; BIM for design, BIM for Construction, and BIM for Facilities Management. Each module contains essential concepts and case studies which are ready to use education materials in class. Extended readings were also provided for each module. A total of 20 participants joined the online training module. They were mainly academics and HDR students of the School of CEBE.

Participants were encouraged to reflect on what they have learned and share their experiences in the discussion forum. By completing the module, participants would be able to plan how to incorporate BIM into their teaching and learning activities and be aware of the opportunities of using BIM for cross-disciplinary units.

### 3.2 Conduct BIM workshops

A two-day BIM workshop (<https://www.eventbrite.com.au/e/building-information-modelling-bim-workshop-tickets-25919695507>) was conducted on 14 and 15 June 2016. It was held in a computer laboratory. It provided hands-on BIM training to demonstrate how BIM facilitates collaborative practices from design to construction and operation. Three prominent speakers from the industry were invited to showcase the latest BIM practice in the industry. A total of 25 academics and HDR students participated in the two-day BIM workshop.

The first day focused on BIM concepts and its application to building projects whereas the second day focused on infrastructure projects. Participants were provided with the opportunities to work on the BIM models with Autodesk Revit and Navisworks. A number of softwares such as Asta, Synchro, and Tekla were introduced. BIM Workshop materials were shared with all the academics at the School of Civil Engineering and Built Environment by email the day after the BIM workshop.

## 4 Findings: Observations & Evaluation

The following strategies were adopted to evaluate the usefulness of the online training module and the BIM workshops:

**Table 1** Evaluation strategies for the learning and teaching initiatives for BIM education

Key Evaluation Questions	Evaluation Data Sources	Data collection and analysis methods to inform the overall project outcomes
Does the online training module achieve predetermined learning outcome?	Evaluation from participants	Participants were invited to fill in an online evaluation form to reflect the learning experience of the online module
Do the workshops provide useful skills and information?	Evaluation from participants	Participants were invited to fill in an evaluation form to reflect the usefulness of the workshops
What is the increase in BIM education in coursework units?	Unit descriptions	Review of unit descriptions and assessment of total BIM content Introduction of new BIM-based units

#### 4.1 Evaluation of the online training module

A total of 4 participants completed the BIM competency survey before they began the training. They expressed particular interest in scheduling, integrated project delivery and clash detection. One participant would like to know more about interoperability issues and solutions including possible computational and automated concepts that help resolve these problems as well as workflows and collaboration whereas another participant was interested in 5D BIM.

Over the discussion with two participants, the online training module was useful and achieved the predetermined learning outcomes. As compared with the level of BIM knowledge before taking the online training module, the participants' level of BIM knowledge after taking the online training module was higher and their awareness for BIM education has been raised. Regarding what they liked most about the online training module, they expressed that they liked the case studies and videos which could be handy educational materials to be used in class. Due to limited time, not many participants could afford to try all the modules. Most of them focused on the module relating to their own discipline in particular.

It was found that there was varied enthusiasm among academics at School of CEBE towards BIM. Some do not see the direct relevance to their work. Some find it hard to spare extra time participating in the online training module which has no immediate needs to them. This echoes with the literature that there are obstacles of taking up BIM education because of the lack of enthusiasm to change the teaching habits among AEC academics (e.g. MacDonald 2012; Rooney 2015).

Perhaps, the current self-paced no formal obligation approach needs to be reconsidered. More thoughts are needed on how to motivate academic staff to participate in the online training module. Up to 3 BIM Academic Innovation Awards [Gold Class Cinema Vouchers] were proposed to be given to participants who submitted an independently developed, innovative idea for embracing BIM in teaching and learning/ research / professional practice to the Eureka Centre - Creative Space page of BIMConE on or before 31/3/2016. Selection criteria include: 1) innovation and 2) feasibility. However, no one was qualified for the award. It would be interesting to know what would be the effective motivation for academics to commit to the training.



## 4.2 Evaluation of BIM workshops

The BIM workshop went well with participants full of enthusiasm. It was interesting to find that the BIM workshop attracted quite a number of HDR students and staff members in other schools of the Science and Engineering Faculty. Some of them joined out of personal interest whereas some of them were undertaking their doctoral research related to BIM. The participants showed genuine interest and followed up with the project team for further information and resources of BIM training.

According to the participants' evaluation, the overall assessment of the event was 4.5 (1= insufficient-5 = excellent). All of them agreed that the workshop raised their awareness and stimulated their interest in BIM. The workshop also met their expectations and they agreed that their BIM knowledge increased. Some participants expressed that they would like to see more applications of BIM on infrastructure projects.

One area to improve was that more time should be provided for using different BIM related software packages in the workshop. More live demonstrations should be provided. These comments are not surprising. According to Wu and Issa (2013), there is a dilemma in BIM education to strike a balance between concepts and software applications. There is not enough time to cover everything about BIM in two sessions. There is a general consensus that BIM educators should mainly equip students with concepts and theories because software application changes quickly and there are so many different software packages in the market. This is exactly the constraint we faced when planning the two-day BIM workshop. With the time constraint, we decided to adopt a blended learning approach with a focus on the concepts and supplementary with some hands-on software applications.

The BIM workshop received seemingly greater support than the online training module among academics and HDR students but they are complementing each other. Some BIM workshop participants joined the online training module after attending the BIM workshop. There are three noteworthy key for success for consideration in the future. Timing plays an important role for the success. The online training module was launched one week before the orientation week of semester 1 2016 when academics were busy preparing for the new semester. The BIM workshop was held when the teaching period was finished. Perhaps a consultation on the timing for providing learning and teaching support needs to be conducted with the potential users in the future planning. The person who delivers the training is decisive for success. The BIM workshop was delivered by three prominent BIM experts from the industry. The design and delivery mode is also an important success factor. Face-to-face training seems to be the preferred option of people who are not familiar with BIM and the participants treasured the opportunities to have hands-on experience in using the BIM software packages in the computer laboratory. This distinguished the BIM workshop from other BIM meetings such as BrisBIM.

## 4.3 Evaluation of BIM elements the curriculum

UXB111 Imagine Construction Management, as a first year first semester unit for construction management students, has included BIM as a key component and one of the assessments. UXB211 Building Services has potential to include clash detection. It is expected that there will be more opportunities for incorporating BIM especially when the educators see the benefits of BIM.

## 5. Conclusions and implications for the future

To conclude, lack of knowledgeable BIM academics is one of the key obstacles for BIM education development. More learning and teaching support is needed. Only limited information is available on the design and effectiveness of the learning and teaching support for BIM education. This paper evaluated the design and effectiveness of two learning and teaching support initiatives for BIM education at QUT, namely the online training module and the BIM workshops. This project served its purpose to raise the awareness of BIM among QUT staff.

The online training module is an efficient learning and teaching resources for BIM educators to build up their BIM capabilities. It can also be the learning resource for AEC students. The online training module will continue to be improved and updated. The BIM workshop had good outcome and feedback from the participants. A combination of good timing, face-to-face delivery method, industry speakers, and hands-on experience in the computer laboratory are probably the keys to success.

Overall, the greatest challenge for designing effective learning and teaching support for BIM education is the lack of motivation among some of the AEC educators. For those motivated learners for BIM education, they found this project useful and relevant to them. They were willing to spend time and effort participating in the online training module and the BIM workshops. If the university would like to strengthen BIM education, sustained effort for learning and support would be needed. The enthusiasm of the HDR students was encouraging. Since HDR students are eligible to work as sessional academics, they can be a good source of support to BIM education.

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